NOTES ON A BEROID OF PORT JACKSON.

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On March the 18th, 1827, a Beroë was captured by the "Coquille" in Port Jackson, which Lesson (9, p. 103) describes in the following manner :—le nouveau genre de zoophyte a cils, est remarquable par son corps aminci sur ses deux faces en coin, obcordé au pôle supériéux, et largement ouvert au pôle natateur. L'axe cavitaire est allongé, étroit, bordé sur ses deux faces de cils unis en haut et libres en bas, et de deux rougeés sur tous les boids, soit des pôles soit des côtes.

This description is accompanied by a very fair illustration (9, pl. XVI., fig. 2), which enabled me to identify an animal found by myself with Neis cordigera, Lesson, without difficulty.

I consider myself justified in redescribing this Ctenophore, because Chun (3, p. 306) very correctly remarks that the Beroids not examined by himself have hitherto not been adequately described ; and the more so as the histological examination of it has furnished results which are of some interest.

Whilst L. Agassiz (1, p. 89) considers Lessons Genus Neis, as a representative of a separate Sub-family, Chun (3, p 307), thinks that Neis is identical with Beroë.

I will pass over the question of the propriety of making a special Sub-family for Neis as unripe for discussion, but wish to remark that I cannot coincide with Chun's plan of placing all the Beroids in one Genus, viz :—Beroë. The good plate of Neis in the Atlas of the Coquille Zoologie (9, pl. XVI.), should have, I think, convinced him that Neis is no Beroë. Here in the colonies I have often had the opportunity of observing lower marine animals which have been described by former authors, and I should like to state that in general these descriptions are by no means so bad or insufficient as modern zoologists seem to think.

I cannot enter further into the classification of the Beroids, but I am quite sure that Neis represents a Genus distinct from Beroë, and in many points represents a transition from Beroë to the Lobatæ and even to the Tæniatæ.

For sixty years no one seems again to have observed Neis cordigera, perhaps the most beautiful animal in the rich Fauna of Port Jackson. I have repeatedly found single specimens of it, this spring, accompanying the swarms of flapped Ctenophore described by me as Bolina Chuni (8), in those parts of the harbour to which the currents bring great numbers of pelagic animals.

MORPHOLOGY.

Our animal differs from the Genus Beroë principally in two points. It has large flaps which extend far beyond the pole of the nerve centre, and the vascular system of the gallert in one half of the body is not separated from that of the other half as according to Chun (3, p. 57) in the case of Beroë.

Size.

The largest specimen attained a length of 200—250 mm. The animal is about 2—2½ times as long as broad and 4—5 times as long as thick.

Form.

In shape Neis is, in so far intermediate between Beroë and Lobatæ, as the nerve centre does not lie at the extreme end of the body but is overlapped by two flaps which are almost ¼ as long as the body. The body appears to be more compressed than in most of the species of Beroë. The flaps have an almost triangular transverse section as the paddle-ribs which form the edges are so near together on the inner side, that they almost touch each other. Viewed on the broad side the body appears almost square, setting aside the flaps. Slightly contracted in the oral third it widens slightly towards the end. The longitudinal section vertical to the stomach-plane has a nearly oval contour. Also the narrow sides are widest in the middle. Towards

the top they diminish very rapidly in width whilst the edges are straight and but slightly converging towards the mouth-pole, so that the whole resembles a gothic arch. The surface of the broadsides is slightly retracted between every pair of paddle ribs, so that the six broad stripes thereof appear concave. The surface of the narrow side is convex.

Paddle-Ribs.

The eight paddle-ribs are not of equal length as the four which lie nearest to the stomach-plane, circumscribe the flaps whilst the four others diverge but slightly from the shortest meridian. They are convex in their distal part. Towards the mouth the eight paddle-ribs run almost parallel. Also herein Neis resembles the Lobatæ more than Beroë. The difference in length of the aboral parts of the paddle-ribs observed in the Lobatæ is even greater in Neis, so that it might, as far as the paddle-ribs are concerned, be considered as a transition form between Neis and Beroë.

Nerve Centre.

The organ of sense at the aboral pole does not show any particular peculiarity, it lies of course in the saddle between the flaps. The Pole fields with their fringes lean on the slopes of the flaps and turn their faces towards each other. They are 2 mm. long, $1\frac{1}{2}$ mm. broad and differ only in so far from the corresponding organ of Beroë as the fringes are ramified only in the proximal part and even there only slightly. The fringe on the distal part consist of simple finger-shaped excrescences. I have studied the minute structure of this organ by means of sections.

The results I have arrived at corroberate the statements of former investigators in particular those of Richard Hertwig (6, p. 339, ff) and Chun (3, p. 165-167). I find that the fringes in especial are clothed with a high Epithelium which consists of broader ciliated cells and slender nervous, sensitive elements. This Epithelium resembles that of the extreme zone in the mouth margin and we shall speak of it again below.

Gastrovascular System.

The stomach and the vascular system stamps our animal as a real Beroid. The *stomach* is in no degree influenced in its form by the flaps but has the simple shape of a cone or sack. I was able to observe the peristaltic movement of the stomach. Only one stricture occurs at a time. It begins above the mouth progresses quickly upwards and reaches the aboral end in about a second and a half. The stomach is thereby constricted to a fourth of its usual diameter. As soon as the contraction has reached the end, a fresh one commences at the margin of the mouth.

This peristaltic movement can be reversed and I consider this as very important. If the animal is not killed at once but is allowed to lie in slowly acting reagents this reversed peristaltic movement can easily be observed.

If a Neis dies slowly in a mixture of 16% alcohol, 16% glycerine, 0·5% corrosive sublimate and 67·5% sea water, the reversion of the movement of the stomach described above, sets in soon after the animal is placed in this preparation. The vomiting movement at first recurs rapidly and afterwards when the animal is near death it can be brought on again in a less degree by mechanical irritation.

The stomach is as Agassiz (1, p. 74) at length describes, extraordinary mobile and our Neis can without difficulty swallow animals larger than itself.

The Vascular System.

The Vascular System of the Gallert consists of eight stems which spring from the stomach in the same manner as Chun (3, p. 56 and elsewhere), describes it in the case of Beroë. The vascular reticulation differs in as far from that of Beroë (3, p. 57) that it forms a continuous network, and is not divided into two separate vascular systems.

The vascular reticulation of Neis is much more highly developed than that of Beroë. Whilst in Beroë the canals form a reticulation of scarcely more than one superficial layer, in Neis the network extends in three dimensions from the superficial, tangental canals, branches extend centripetally and pervade the gallert reaching to

the stomach. These ramifications become finer and finer and end as fine capillaries outside the surface of the stomach. Towards the mouth the network is very fine and indistinct, but can be demonstrated by means of injection with osmic acid without difficulty.

The vascular reticulation of the flaps consists of nearly parallel longitudinal canals, which run upwards and end vertical to the surface, diverging accordingly in graceful curves. These stems are connected with one another by transverse canals of similar width so that a ladder-shaped network is formed which resembles the skeleton of Spongelia in shape.

In the middle between each pair of meridian canals, the vessels of the reticulation are much larger than near the stem, their diameter is here almost three times as great.

The Sexual Products.

Ripe sexual products are exclusively found in those parts of the vascular reticulation which are most remote from the meridian canals. The latter never contain ripe ova or spermatozoa.

In this aspect also, Neis differs essentially from Beroë (3, p. 62) and Idyia (1, p. 285), as in these it is just the meridian canals and the proximal part of the vascular reticulation which contain the sexual products, whilst the more distant parts of the vascular net work remain sterile. I have made no observation which would tend to prove an Ectodermal origin of the sexual product, which Claus (4, p. 299), and Richard Hertwig (6, p. 426) assume.

As compared with Beroë, Neis accordingly shows a greater differentiation; the maturing area of the sexual cells is conveyed from the meridian canals to the reticulation.

According to Chun (3, p. 191), the female sexual products are modified Epithel cells. I assent to this assumption, but I believe that the ova are Sub-epithelial and do not lie on the surface. In a transverse section through the meridian canal it can easily be observed, that cells lie beneath the Entodermal Epithelium as highly coloured (Alumn Carmin) nuclei lie in abundance between the canal Epithelium and the Gallert. Such nuclei are also found

beneath the Epithelium of the canals of the network, which originate from the meridian canals. The latter are a little larger than those in the meridian canals. At a greater distance from these canals, ova are clearly seen, which increase in size the further they are removed from the meridian canals.

In those parts of the vascular reticulation which occupy the middle of the fields, the canals appear thickly filled with ripe ova.

From these observations I think I must draw the conclusion that the place of germination of the ova lies in the meridian canals, whilst their maturing place in Neis is removed to the canals of the reticulation.

Single Entoderm cells of the meridian canal epithel sink down into the sub-epithelium and wander along it into the vascular reticulation. During this migration they increase in size. At length they remain in those parts of the network vessels, furthest removed from the meridian canals and there develope into mature ova. The spermatoza are found united in balls also in the reticulation canals.

As to the origin of male products I have arrived at no satisfactory conclusion. It is of course not impossible that the ova-germs migrate from the Ectoderm, first into the subepithelium of the meridian canals, and then continue their migration in the manner described above. But this I do not consider probable. The whole process appears somewhat analogous to the formation and migration of the ova in many Hydromedusæ. (11.) The same cause which Weisman ascribes to the migration of these elements in the Hydroids cannot be accepted for our Ctenophore. I see in this process rather a further development of that met with in Beroë Forskalii.

The Margin of the Mouth.

The mouth-margin of Beroë is clothed by a highly developed Ectoderm which Chun (3, pp. 33, 159, 160, Taf. XV., fig. 19) and Richard Hertwig (6, pp. 333-337, Taf. XIX., figs, 11, 14, 15, 17) have described and figured.

The mouth-margin of Neis cordigera resembles that of Beroë in so far as below the free margin the same three zones are met with

which the authors mentioned describe. The figures of Richard Hertwig resemble this part of Neis so closely that I consider it unnecessary to describe it more minutely. The zone of the gland cells is not embedded in the Gallert, as Chun represents. The only essential difference, in this respect, between Neis and Beroë is met in the zone of the ciliated cells.

This is mainly supported by excrescences of the Gallert, which are ring-shaped. The ciliated cells radiate from the Gallert-ridges, and remind us in this respect of the so often described appearance in other Cœlenterata. These ciliated cells agree with those of Beroë, which Richard Hertwig describes (6, p. 334,) *but between them are found slender granulated sensitive cells*, which resemble the homologous elements in the fringes of the Pole-fields very closely, and possess the type of the ectodermal sensitive cells of other Cœlenterata.

Between the ciliated and sensitive cells on the one side and the Gallert on the other, are found in this zone exclusively, numerous pear-shaped Ganglia-cells which appear connected with the sensitive cells by very fine nervous threads. Towards the aboral pole they are continued into a thick granulated nerve which can be traced for some distance without difficulty on longitudinal sections and on surface preparations.

Style-cells.

Concerning the sensitive cells with styles of Cestus, Eucharis and Beroë, described by Richard Hertwig, I have arrived at a conclusion which differs essentially from that adapted by him and by Chun. I consider these elements not to have a mainly sensitive function. As well in the Papillæ of Eurachis multicornis as in those of Cestus and in the homologous zone of Beroë these large styles which differ by their thickness and the different refractive power from ordinary sensitive cilia, are very striking, they are always found thickly surrounded by gland-cells. In other Cœlenterata such styles are never to be found. The Palpocils of the Sarsia-polypes (10) alone can be compared with them, and these are very different in shape and of unknown function. The sensitive cilia of other Cœlenterata are much finer and resemble the cilia of those sensitive cells, which

are found on the sensitive pole and on the mouth-margin of Neis. I have in vain looked for ganglia-cells below the style-cells and I cannot find any notice in literature that below these the ganglia-cells are more numerous than elsewhere, which must necessarily be the case if these cells really are sensitive.

I think, therefore, that I am justified in assuming that these styles are *poison thorns* and not sensitive bristles. Accordingly I suppose the glands surrounding these cells to be poison glands. The position of these elements in the Beroids and still more in Cestus and Eucharis appears to me to prove conclusively that they are *defensive weapons* which represent the thread cells.

In detail it is true that such an analogy cannot be traced, but the outer similarity in the arrangement, form and chemical behaviour with regard to re-agents which exists between these organs and the nettle-epithelia of other Cœlenterata is very striking.

The style-cells are often drawn out into a continuation downwards. This can just as easily be taken for a peduncle as for a nerve. And even were we to ascribe nervous functions to these style-cells, the other functions mentioned above might co-exist therewith. The recurved sabre-formed cilia of the stomach-epithel do not show any essential difference with the hooked teeth in Beroë.

The Color.

The Gallert and Epithelia are colorless, only those cells which cloth the vascular reticulation, especially when the animal contains ripe sexual cells, are slightly rose-coloured. Below the surface of the narrow sides there is a beautiful orange red reticulation formed by pigment cells. Just below the surface the threads of this reticulation are very thick, and are spread out tangentially. Fine radial ramification extend from this surface-net in a centripedal direction pervading the Gallert. This can be traced for a distance of about 8 mm. The meshes of this pigment reticulation are smallest just below the surface between the paddle-ribs, so that in the middle of the narrow side an indistinct orange stripe is produced. The yellow pigment is wanting on the ends of the narrow sides in the vicinity of the

sensitive pole. Single groups of the *spindle-shaped* pigment cells are found also in other parts of the body, so on the paddle-ribs and the mouth margin.

As appears from this description of the colour my specimens are not exactly similar to those of Lesson (9, pl. XVI., fig. 2.) I should however, not consider this as of any importance, as the colouring of the plates in the Coquille Atlas is not very accurate.

I am at present so loaded with other work that I have not the leisure to examine all the organs of Neis in the same minute manner, and I have therefore directed my attention to those which seemed to me most interesting.

I have again endeavoured to prove a connection between the Sub-epithel nervous plexus with those Mesodermal threads which Eimer (5) has declared to be nerves, and to which also Richard Hertwig (6) is inclined to ascribe a nervous function. It is true I do not agree with Chun (3), who denies that these Mesodermal fibres are nervous, but I must confess that my endeavours to find this connection in Neis have been as fruitless as in Cyanea.

LITERATURE.

Concerning the complete literature I refer to Richard Hertwig's list (6.)

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